ON THE HYDRO-BIOLOGICAL DATA COLLECTED ON THE WADGE BANK EARLY IN 1949.*

BY

K. CHIDAMBARAM

AND

A. D. ISAAC RAJENDRAN

(*Fisheries Biological Station, Tuticorin*)

INTRODUCTION

In 1907 Hornell, when he was attached to the Ceylon Company of Pearl Fisheries, Ltd., arranged for a trial cruise to areas of comparatively shallow water, within 100 fathom line off Cape Comorin, with a view to locating trawling grounds, if any, aboard the S. T. 'Violet', under the skipper Captain Gibb. During this cruise he struck a trawling ground lying to east, south and west of Cape Comorin within the 100 fm. line, where dredging beyond the 17 fm. line indicated the presence of 'fine grey sand' free from any obstructions to fishing. Hornell reported this area rich in fish and so extensive as to offer good fishing for an indefinite period to a large fleet of steam trawlers of full power and size. This bank is known as 'Wadge Bank' and it extends to a distance of more than 50 miles off shore and covers an area of more than 4,000 sq. miles. The bank is exposed to the S.W. and N.E. Monsoon and hence fishing operations are greatly influenced by the monsoon; during certain months of the year fishing will be practically impossible even by modern vessels due to the strong current prevailing at the time. The Wadge Bank has been explored by the Madras and Ceylon Governments in the succeeding years on a few occasions; the Madras Government worked the trawler S T. 'Goschen' between 1927 and '29. Experimental trawling was conducted by the Ceylon Government in 1913–14 and from 1919 in 'Violet' and 'Lilla'. In 1945 the Department of Fisheries in Ceylon commenced commercial trawling with S.T. 'Raglan Castle'.

In February 1949, the Deep Sea Fishing unit of the Madras Fisheries planned to explore the Wadge Bank areas from the Indian side to determine the economic value of the operations by a small fleet of vessels including the departmental vessels, 'Lady Nicholson', M.F.V. 'Gouhar Khaleeli' and M.F.V. 'Tuticorin'.

The fishing operations commenced on February 2, 1949, and ended on April 8, 1949. As the vessels had to return after a day's fishing to dispose of the catch in fresh condition, fishing was possible once in three days, subject to favourable weather conditions. Under changing conditions of weather, fishing was possible that year only on three days in February and on six days in March 1949. The grounds fished were more than 30 miles off and sometimes 60 miles off the coast. The fishing gear used were ordinary hand lines with four to five hooks attached to each line.

---

* With the kind permission of the Director of Fisheries, Madras.

The work was purely of an exploratory nature, to determine the efficiency of line fishing in those areas. Incidentally, opportunity was seized to collect certain hydro-biological data during the few weeks of operations.

ACKNOWLEDGEMENT

Our thanks are due to Messrs. A. I. George, Assistant Director of Fisheries, and Tahar Shariff, Inspector of Fisheries, and the crew of the vessels for the assistance given in the collection of data and in the analyses of the catches.

PHYSIOGRAPHY

From Manapad to Cape Comorin there is a foul shore composed of coral reef and rock extending from the beach to 9 fm. contour. A similar inshore belt from Cape Comorin to Muttam point and even as far as Trivandrum is of fine clean sand, free from obstruction. Towards Trivandrum this sandy belt seems to extend beyond 9 fm. up to 27 fms.

South-south-east of Manapad beyond the 20 fm. line, roughly at a distance of 25–30 miles from the shore, good trawling ground with fine coarse sand, free from obstruction, is found extending to 100 fm. line. This belt of good fishing ground is quite narrow but widens out towards the west and south-west. South of Cape Comorin the belt stretches for about 35 miles. South, south-west and west of Cape Comorin, the belt reaches its maximum width of nearly 50 miles. West of Muttam, it narrows again to about 35 miles. The whole of this belt is composed of sand and dark agglutinated sand. Further north, along this belt, broken masses of dead loose coral were met with though the ground is trawlable. Fine ground, however, stretches, in a narrow belt well within the 50 fm. line, west and north-west of Muttam. South-west of Cape Comorin at a distance of about 25 miles, there is a huge cluster of submerged rocks rising to a height of 5 fm. to 33 fms. above the surrounding sea bottom. (*vide* the Admiralty Chart). Though trawling can be done **to within** the limits of this rocky patch, no trawling is possible over it. The depths range from 45 to 65 fms.

MATERIALS AND METHODS

The motor schooner 'Lady Nicholson' and motor fishing vessel 'Gouhar Khaleeli' were engaged in fishery survey along with three Tuticorin type of canoes. Thirty fishermen and the crew of the vessels were engaged in fishing at one time or another. The two power vessels reached the fishing ground where they served as mother vessels, when the canoes were engaged in fishing with hand lines. The fish caught were measured, weighed and examined for sex, sexual maturity and stomach contents. The position of the ground was fixed by compass bearings. The water sample was collected from a depth of $\frac{1}{2}$ metre below the surface by a canvas bucket and from the bottom by a water sample bottle. The temperature was recorded in °C and the specific gravity was recorded by Aerometer (Sikes Hydrometer).

HYDROGRAPHY

The hydrographical data recorded were only the temperature and specific gravity of sea water both on the surface and at the bottom of

TABLE I

Hydrographical data collected at Wadge Bank

Station	Position	Date and Time	Temperature °C.		Sp. gravity		Current		Nature of bottom	Depth
			Surface	Bottom	Surface	Bottom	Surface	Bottom		
Wadge Bank S. 45°E. 55 miles from Punjal perumanal.	7°31′ 2″N. 77°55′ 8″E.	4-3-'49								
		8 a.m.	25·1°	27·6°	1·025	1·026	NW—SE	...	Rock	45 fm
		12 noon	26·0°	27·2°	1·025	1·026	NW—SE	...	with	,,
		4 p.m.	27·0°	26·6°	1·025	1·0.6	NW—SE	...	sand	,,
Wadge Bank S. 45°E. 20 miles. S. 40° E. 38 miles from Leepuram.	7°30′ 45″N. 77°46′ 45″E.	14-3-'49								
		12 noon	26·2°	26·8°	1·025	1·026	NE—SW	...	Rocky	49 fm
		4 p.m.	27·1°	26·4°	1·024	1·026	NE—SW	...	Rocky	,,
Wadge Bank S. 45°E. 50 miles from Leepuram.	7°28′ 5″N. 77°40′ 50″E.	16-3-'49								
		12 noon	26·0°	26·2°	1·024	1·027	NW—SE	...	Rocky	55 fm
		4 p.m.	27·3°	26·0°	1·026	1·027	NW—SE	...	Rocky	,,
Wadge Bank S. 20° E. 55 miles from Leepuram.	7°24′ 55″N. 77°31′ 22″E.	18-3-'4								
		8 a.m.	25·0°	26·0°	1·025	1·026	NE—SW	...	Rock with sand	65 fm
		12 noon	26·5°	26·2°	1·025	1.026	NE—SW	...	...	,,
		4 p.m.	27·4°	26·0°	1·024	1·025	NE—SW	...	...	,,

S. No.	N
1	2
2	5
3	3
4	5 2
5	5
6	2
7	7
8	4
9	

TABLE II

Details of catches of fishes on the Wadge Bank: Species, their numbers, size & weight

S. No.	Date	Depth	Nature of bottom	Condition of sea	*Lutjanus malabaricus* (Bl. Schr.)			*Aprion typus* (Blkr.)			*Lethrinus lutjanus* (Lac)			*Epinephelus tauvina* (Forsk.)			*E. miniatus* (Forsk.)			*E. bleekeri* (Vaill. & Bocourt)			*E. undulosus* (Q. G.)			Sharks			Total weight of all fish	No. of hand-lines in operation	No. of hours of fishing	Remarks
					No.	Size range	Wt. in lb.	No.	Size range	Wt. in lb.	No.	Size range	Wt. in lb.	No.	Size range	Wt. in lb.	No.	Size range	Wt. in lb.	No.	Size range	Wt. in lb.	No.	Size range	Wt. in lb.	No.	Size range	Wt. in lb.				
						Cms.			Cms.			Cms.			Cms.			Cms.			Cms.			Cms.			Cms.					
1	21-2-49 a.	40–45 fm.	Rocky	Calm	29	30–60	151	2	30–90	8	2	30–60	8	90	30–120	748	5	30–40	39	23	30–90	110	14	30–90	116	1		110		25 H.L. — 3 luggm.	9 hours (9 a.m.—6 p.m.)	(*a*) from luggers.
	b.	,,	,,	Rough	13	,,	68	2	...	14	2	...	10	14	,,	118	...	...	...	...	...	...	4	...	34			1683	2 H.L.	do.	(*b*) from M.F.V.
2	23-2-49 a.	40 fm.	,,	,,	17	30–80	132	15	20–90	76	...	...	...	120	,,	942	17	15–30	40	50	20–60	250	7	20–60	40				25 H.L. 3	do.	
	b.	,,	,,	,,	2	...	14	2	25	6	...	...	..	22	30–90	145	4	20–30	6	...	...	...	...	...	...			1868	3 H.L.	do.	
3	25-2-49 a.	50 fm.	,,	,,	37	30–90	244	...	...	...	...	...	...	154	,,	1315	...	...	...	33	30–60	184	...	...	...				25 H.L. 3	3 hours (1–4 p.m.)	
	b.	,,	,,	,,	...	...	...	...	...	...	...	...	...	72	,,	507	...	...	...	...	...	...	...	...	...			2599	4 H.L.	do.	
4	4-3-49 a.	50 fm.	,,	Calm	54	...	338	9	...	64	...	...	...	374	...	3010	12	...	40	54	...	274	7	...	43				26 H.L. 3	11 hours (6–5 p.m.)	
	b.	,,	,,	,,	38	...	264	4	...	34	...	...	...	59	...	492	...	...	...	20	...	112	3	...	30			4794	3 H.L.	do.	
5	14-3-49 a.	49 fm.	,,	,,	16	48–63	101	8	45–75	48	2	38–63	14	86	40–68	650	18	33–45	67	50	35–50	256	7	55–72	59				30 H.L. 4	do.	
	b.	,,	,,	,,	...	...	...	...	...	...	...	...	...	25	40–50	125	...	...	...	...	...	...	...	...	...			1340	3 H.L.	do.	
6	16-3-49 a.	49 fm.	,,	,,	12	48–65	84	...	...	...	...	...	...	44	40–85	334	8	25–35	28	27	35–50	124	...	...	...				30 H.L. 4	8 hours (9–5 p.m.)	
	b.	55 fm.	,,	,,	...	...	...	10	45–50	60	...	...	...	8	45–65	64	...	...	...	...	...	...	...	...	...			733	4 H.L.	do.	
7	18-3-49 a.	65 fm.	,,	,,	...	...	...	63	48–72	546	...	...	...	77	65	604	6	30–45	22	76	35–54	352	...	...	...				30 H.L. 4	do.	
	b.	,,	,,	,,	29	40–55	184	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...			2496	4 H.L.	do.	
8	23-3-49	65 fm	,,	,,	...	...	...	51	48–80	458	...	...	...	159	45–75	1005	...	...	...	49	35–50	145	...	...	...	2	165–180	168	2185	30 H.L. 6	do.	
9	25-3-49	65 fm.	,,	,,	20	48–50	126	137	48–80	744	...	...	...	99	45–72	598	...	...	...	...	...	...	...	...	...				1614	30 H.L. 6	do.	

the sea. These were registered at 8 a.m., 12 noon and 4 p.m. Only on 4 days, viz., 4th, 14th, 16th and 18th March 1949, was it possible to record the data. On other days the rough seas and rolling of the vessels prevented collection of samples, with the available equipment. The surface temperatures ranged from 25·0° C at 8 a.m. to 27·4° C at 4 p.m. and bottom temperature from 26·0° C at 4 p.m. to 27·6° C at 8 a.m. Temperature was lower at the surface in the mornings and then gradually increased and was higher than the temperature at the bottom as the day advanced. Specific gravity of sea water ranged between 1·024 and 1·026 at the surface and between 1·025 and 1·027 at the bottom. It was always higher in bottom samples than in the surface samples. The details are given in Table I.

Fishes

Details of catches of different commercially important varieties of fish on the bank during the days under review, are presented in Table II.

TABLE III

Details of total catches of each genus on the Wadge Bank

Date	*Epinephelus* spp.	*Lutjanus* spp.	*Aprion pristipoma*	Total weight of all fish
	Lb.	Lb.	Lb.	Lb.
21—2—49	1,165	219	22	1,683
23—2—49	1,477	146	82	1,868
25—2—49	2,006	244	...	2,599
4—3—49	4,075	602	98	4,794
14—3—49	1,157	101	48	1,340
16—3—49	550	84	60	733
18—3—49	1,113	184	546	2,496
23—3—49	1,150	...	458	2,185
25—3—49	598	126	744	1,614
Total ...	13,291	1,706	2,058	19,312

The catches comprised mostly of sea bass, *Epinephelus* spp. and Snappers, *Lutjanus* spp. and *Aprion* (*Pristipomoides*) *typus* (Blkr.). There were a few sharks and sea breams. The genus *Epinephelus* was represented by *E. tauvina* (Forsk.), *E. miniatus* (Forsk.), *E. bleekeri* (Vaill. and Bocourt) and *E. undulosus* (Q.G.). The only species of *Lutjanus* common in the catches was *L. malabaricus* (Bl. Schnr.). *E. tauvina* (Forsk.) was predominant, accounting for a little over half of the total catch. They ranged in size between 30 cms. and 120 cms. They were immature. The body weights of a 50 cm. male and female were 3·7 lb. and 2·5 lb. respectively and those of a 62·5 cm. male and a female, 8·5 lb. and 7·5 lb. respectively. They had fed mostly on other fish. *E. bleekeri* (Vaill. and Bocourt) was next in importance and ranged in length between 30 cms. and 90 cms. These were immature and had fed on other small fish. The other two species of *Epinephelus* were poorly represented.

The fish *Aprion typus* (Blkr.) was next only to *E. tauvina* and the range in length of these species was between 20 cms. and 90 cms. The gonads were not ripe and they had consumed only fish.

Lutjanus malabaricus (Bl. Schnr.) ranked fourth in importance in the catches and it ranged in length from 30 cms. to 90 cms. The gonads were not ripe. All these species had in their stomach small trigger fish, *Balistes* spp.

Of the total quantity of 19,312 lb. of fish landed on nine days by hand lines, 13,291 lb. belonged to *Epinephelus* spp.; and *E. tauvina* (Forsk.) alone accounted for 10,657 lb. On the three days of fishing in February 6,150 lb. were landed and on 6 fishing days in March, 13,162 lb. were landed. Based on the number of hours of fishing and the number of hand lines employed, it works out to 33·2 lb. of fish per hour per line. Expert fishermen land four to five fish at a time, otherwise it may not be worth the trouble of landing one fish at a time and to haul up the line for 100 metres !

Discussion

The range of variation in temperature of surface layers of the sea on the Wadge Bank has been between 0·9° C to 2·4° C; and that of the temperature of the bottom layer between 0·2° C to 1° C. There does not seem to be any direct relationship of the trend of temperature variation of the surface layer with that of bottom layer. But in the diurnal variation of temperature at the bottom layer, it is noticed that the maximum range of 1° C was observed at a depth of 90 metres and the variation has been 0·4° C at a depth of 98 metres, 0·20° C at 110 metres and 130 metres. This indicates that the range of diurnal variation of temperature gets reduced as the depth increases in this region. Presenting the table of temperature at different depths in the Gulf of Manaar in January 1921, Sewell (1929) recorded that 'in five instances out of eight the surface temperature is lower than the temperature at a depth of 50 metres and again this occurs at any time of the day, so that it does not depend on the greater cooling of the surface water during the night' and in these two southernmost stations near Wadge Bank, they are so. Sewell further indicated from the data of temperature and salinity recorded in March and April 1920 in the southern regions of the Gulf of Manaar from surface to a depth of 50 metres that once late in April the temperature of surface water was less than that at a depth of 50 metres and also that 'during the winter months surface water of Indian Seas, or at any rate of certain areas, may be colder than that lying at a depth of some 20–25 metres and, furthermore, that this condition is specially likely to be present during the night and early morning hours'. Similar trend of variation in temperature in the surface and bottom layers of the four stations in the Wadge Bank in the month of March 1949 was observed by us; the surface temperature being less in the morning than that at the bottom at depths more than 90 metres and higher at the surface than at the bottom in the afternoon at 4 p.m.

Sewell (1929 p. 309–311) observed that in the latter part of April and May, and in October and November, the surface waters might be more saline than that at a lower depth and that in the north-east monsoon months of January and February the surface water would be less saline than that below. He had also indicated that the variations

might be caused by the force of wind and the prevailing temperature of the sea water. In March 1949, it was not possible to estimate the salinity. If specific gravity could be taken as indication of salinity, it could be said that the specific gravity was less at the surface than at the bottom layers.

Hornell (1916) found the Indian grounds 'greatly superior in extent and richness' to those off Ceylon and observed that the Wadge Bank 'is generally much richer in the daily quantity of fish catchable by each trawler and is so extensive in area as to offer good fishing for an indefinite period to a large fleet of steam trawlers of full power and size. This ground comprises the whole of that wide submarine plateau within the 100 fm. line which lies off Cape Comorin on the western, southern and eastern aspects . . . On the Cape Comorin grounds so long as the fishing was carried on outside of the 17 fm. line plenty of fish were everywhere met with . . . The trawl skipper of the 'Violet' returned to port enthusiastic over the trawl potentialities of the Cape Comorin Bank of soundings both in regard to the large quantities of good quality fish to be had there and to the clean and unobstructed nature of the bottom.'

Sundara Raj (1931) while reporting on the survey of deep sea fishing grounds by S. T. 'Lady Goschen' observed that 'the noteworthy changes since 1907 in this area are (i) that good trawl ground with sand bottom was not met with upto about 20 fathoms south and south-west of Manapad and Cape Comorin; (ii) the large rays (Plough fish and Sharks) were not found off Manapad or Cape Comorin, but only on the western margin of the plateau in about 40 fm.' During the trawling experiments of the 'Lady Goschen' in 1927–28 and 1928–29 trawling on the Wadge Bank was carried on in depths less than 50 fms. excepting on one occasion, when the trawl was shot at a depth of 60 fms. During these trials the rate of catch per hour worked out to 140 lb. in 1927–28 and 200 lb. in 1928–29, as indicated below :—

TABLE IV

Rate of catches of fish by S. T. 'Lady Goschen' (1927–29) in Wadge Bank

Year.	No. of days fished	No. of hauls and hours fished		Total catches in lb.	Catches of *Epinephelus* spp. in lb.	*Lutjanus* spp. in lb.	*Lethrinus* spp. in lb.	Rate of catch per hour	Depth fished
		Hauls	Hours						
1927–28	8	19	66½	9296 lb.				140 lb.	22–47 fms.
1928–29	11	22	79¼	15904 lb.	2032 lb.	2114 lb.	2106 lb.	200 lb.	22–37 fms.

Malpas (1926) referring to the Wadge Bank indicated that 'the bank is fishable upto 100 fathom overall.' In 'Lilla', no information was

available for trawling on the banks in depth exceeding 45 fm. The average rates of catch per hour by 'Lilla' on the Wadge Bank in depths between 11–20 fm. and between 21–45 fm. were 157·7 lb. and 238·4 lb. respectively with a large proportion of the best class of edible fish. For the above two vessels, the data on average catch per day's absence are not available; but for the vessels which operated on Wadge Bank from Ceylon after 1928 the details of average catch per day's absence are taken from the report 'Commercial Trawling in Ceylon Seas' by Amirthalingam and De Zylva and they are presented below :—

TABLE V

Average catch per day's absence on Wadge Bank

Names of the Power Vessels used for trawling	Average No. of days absent annually (in years)	Average catch per day's absence (hundreds of lb.)	Average annual catches (Hundreds of lb.)
'Bulbul' ...	175·5 days 1928 to 1935	42·07	7790·04
'Tongkol' ...	58·5 days 1928 to 1929	28·52	1806·58
'Raglan Castle' ...	71 days 1945 to 1947	55·11	4025·82
'Aringa' ...	154 days 1947	64·07	9867·27

Details of maximum depths at which trawls were tried from the above four vessels and the range of depths where catches were heavy are not available. It has been successively proved that the availability of excellent fishing on the Wadge Bank and the catches on this bank have compared very favourably with the productivity of the trawling grounds elsewhere. This bank is 'beyond the reach of the type of craft now used by local fishermen' (Amirthalingam and De Zylva, 1948).

South-west of Cape Comorin at a distance of about 25 miles, the huge cluster of submerged rocks rising to a height of 30 to over 200 ft. above the surrounding sea bottom termed 'Wadge Bank' in the Admiralty Chart, though not suitable for trawling, is very good for hand lines. As such the methods to be adopted for the development of fishing in the Wadge Bank beyond the range of the existing craft in the Indian waters, will be (1) Hand lines and (2) Trawling. Hand lines have to be operated like the dories working off a mother vessel or from a fast power boat with a special hold to work in the off-shore regions off Cape Comorin. The fishery survey early in 1949 was directed mainly towards the operation of hand lines to find out the productivity of these rocky patches on the Wadge Bank where trawling and long lining at the bottom were not feasible. It will be seen from the details of catches, that the hand lines were operated in beds deeper than 40 fm. and the landings had been at the rate of 33·2 lb. per line per hour.